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REMARKS

Claims 1-31 are pending in the present application. Claims 1-3, 6, and 7

have been provisionally elected. Claims 23-31 are new.

Claims 1, 16, 17, 20, and 25 are independent. Applicants submit that

claim 1 is generic and requests consideration of at least all of its dependent

claims if claim 1 is found allowable.

Claim Rejection - 35 U.S.C. 112, first paragraph, enablement

Claims 1-3, 6, and 7 have been rejected under 35 U.S.C. 112, first

paragraph, as failing to comply with the enablement requirement. In particular,

the Office Action alleges that the added language "to perform white display, in a

surface of the first substrate incoming light to the liquid crystal layer becomes

linearly polarized light in arbitrary directions in a visible wavelength range" was

not described in the specification in such a way as to enable one skilled in the

art to make or use the invention. The Office Action further states that the

specification does not disclose which property of the liquid crystal layer causes

this to occur or how to develop a liquid crystal composition that causes

incident light to be linearly polarized in arbitrary directions.

Applicants submit that the specification does enable one of ordinary skill

in the art to make and use the present invention. In particular, Applicants

submit that it is not one specific property that causes the linearly polarized

light to be transmitted in different directions. The present application discloses

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various combinations of properties that enable one to make a liquid crystal

display device that produces a sufficient black display as well as a sufficient

white display, over the whole wavelength range of visible light. The present

invention produces this superior display quality by the combination of a

circularly polarizing unit that can circularly polarize light over the whole

wavelength range of visible light, a liquid crystal layer that based on the

amount of applied voltage can polarize the light from circularly polarized light

into linearly polarized light. As is disclosed in the present specification (at page

10, first full paragraph), in order to provide a bright state, light should be

linearly polarized on the reflector plate. In order to provide a dark state, light

should be circularly polarized on the reflector plate. The present invention

achieves that objective.

Applicants submit that the properties of the liquid crystal layer of the

present invention are sufficiently disclosed. Properties of the liquid crystal

layer, including twist angle, Δnd , alignment of the crystal molecules, etc., are

disclosed in various ranges, providing a display device that can produce a

superior quality display in both the bright state and the dark state.

With respect to the claim language "arbitrary directions," the Office

action appears to interpret this phrase as if a property of the liquid crystal

layer causes light to be polarized in arbitrary directions. Applicants intended

the claim to mean that the liquid crystal layer of the present invention is such

that it can produce linearly polarized light out of circularly polarized light over

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the whole frequency range of visible light, and will produce a white display

irrespective of the direction of the linearly polarized light; hence the term

"arbitrary." In other words, the term "arbitrary directions in a visible

wavelength range" was intended to be a range of directions that the liquid

crystal layer will operate in producing white display.

In the liquid crystal layer of the present invention, the direction of the

linearly polarized light is dictated by the particular wavelength of the light.

Linearly polarized light of different wavelengths will be transmitted at different

respective directions; i.e., a plurality of wavelengths will be transmitted at a

corresponding plurality of directions. The liquid crystal layer receives light at a

plurality of wavelengths because the circular polarizing unit passes light over a

plurality of wavelengths.

The language of the claim was based on statements made in the

specification at page 43. However, due to the apparent misinterpretation of the

claim as though it recites that the liquid crystal layer has a property that it

causes light to be polarized in arbitrary directions, Applicants have again

amended the claim to explicitly recite the relationship between the direction of

polarization and the wavelength of light.

The direction of polarization is dictated by the wavelength of light, and

this characteristic is due to physical properties of the liquid crystal layer of the

present invention. Properties of the present liquid crystal layer that produce

sufficient bright display and dark display are disclosed throughout the

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specification and drawings. Thus, Applicants submit that the present invention

has been disclosed such that one of ordinary skill in the art can make and use

the present invention. Accordingly, Applicants respectfully request that the

rejection be withdrawn.

Claim Rejection - 35 U.S.C. 112, second paragraph

Claims 1-3, 6, and 7 have been rejected under 35 U.S.C. 112, second

paragraph, as being indefinite. In particular, the Office Action states that it is

unclear if the claim recites that light is linearly polarized in random directions

of if light is linearly polarized in various directions depending on wavelength.

The Office Action has apparently misinterpreted the claim as though it

recites that the liquid crystal layer causes the light to be linearly polarized in

arbitrary directions. As noted above, the limitation of "linearly polarized light in

arbitrary directions in a visible wavelength range" was intended to be a range

that the liquid crystal layer will operated to perform a white display. In any

case, Applicants have amended the claim to explicitly recite the later

interpretation expressed in the Office Action, i.e., the relationship between

direction of polarization and wavelength of light that is caused by properties of

the liquid crystal layer. As mentioned above properties of the liquid crystal

layer of the present invention are disclosed throughout the present

specification and drawings. Thus, Applicants submit that the claim

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amendment answers the concerns expressed in the Office Action. Accordingly,

Applicants respectfully request that the rejection be withdrawn.

New Claims

An objective of the present invention is to produce both a sufficient black

display and a sufficient white display in a liquid crystal display device over a

whole wavelength range of the visible spectrum. Other objectives include

improved manufacturing, i.e., wider tolerances, and reduced power

requirements, i.e., lower voltage levels for the display state requiring voltage. In

order to meet those objectives, Applicants disclose in the present application a

liquid crystal display device having a combination of properties such that it can

meet the requirements for a display of sufficient quality and manufacturability.

In particular, the present invention circularly polarizes light for purposes of

producing a dark state and linearly polarizes light for wavelengths over the

whole visible spectrum for purposes of producing a bright state based on

disclosed properties for the liquid crystal layer, in combination with a circular

polarizing unit and a reflective layer. A minimal set of properties of the liquid

crystal display are summarized in Figure 7, for example. Alternative forms of

the circular polarizing unit and reflective layer are disclosed. One form of the

circular polarizing unit, for example, can produce elliptical polarized light (see

paragraph bridging pages 46 and 47). Thus, new claims have been added to

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cover the scope of the disclosed invention that meets the objectives. Applicants

submit that no new matter has been added.

The present invention includes a liquid crystal layer that polarizes

incoming substantially circularly polarized light into linearly polarized light at

wavelengths over the whole visible spectrum; i.e., the circular polarizing unit

passes light at wavelengths over the whole visible spectrum. When voltage is

applied, the circular polarization unit and liquid crystal layer are such that the

circularly polarized light produces a superior dark display. Further, the

circular polarizer unit produces a white display irrespective of the direction of

reflected linearly polarized light coming out of the liquid crystal layer.

Sonehara (a prior art reference previously applied against the present

invention) discloses a liquid crystal display device in which circularly polarized

light is converted to linearly polarized light which is perpendicular to a quarter

wavelength plate (Sonehara at column 7, lines 15-19). The reflected linearly

polarized light either passes through the linear polarizing plate, producing a

clear display (column 7, lines 6-8), or is blocked by the polarizing plate,

producing a black display (column 7, lines 17-19). The circular polarizing plate

produces a circularly polarized light at a single wavelength (550 nm) in order

for conversion to linearly polarized light perpendicular to the quarter wave

plate.

Thus, unlike Sonehara, the present claimed invention is directed to a

liquid crystal display device having a circular polarizing unit such that

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incoming substantially circularly polarized light at the liquid crystal layer is

polarized in a plurality of directions respectively representative of a plurality of

wavelengths of natural light. An advantage of the present invention is that

manufacturing tolerances such as precision in the thickness of the liquid

crystal layer can be widened, while producing a high quality bright state

display. Because all presently added claims recite this limitation, Applicants

submit that the new claims distinguish over Sonehara.

CONCLUSION

Should there be any outstanding matters that need to be resolved in the

present application, the Examiner is respectfully requested to contact Robert

Downs (Reg. No. 48,222) at the telephone number of (703) 205-8000, to

conduct an interview in an effort to expedite prosecution in connection with the

present application.

If necessary, the Commissioner is hereby authorized in this, concurrent,

and future replies, to charge payment or credit any overpayment to Deposit

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Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully Submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

Terrell C. Birch

Reg. No. 19,382

P.O. Box 747 Falls Church, VA 22040-0747 (703) 205-8000

TCB/RWD/kmr